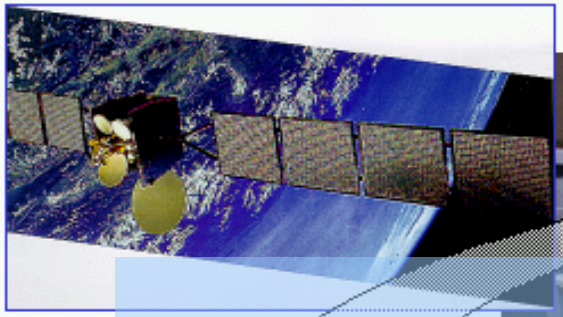
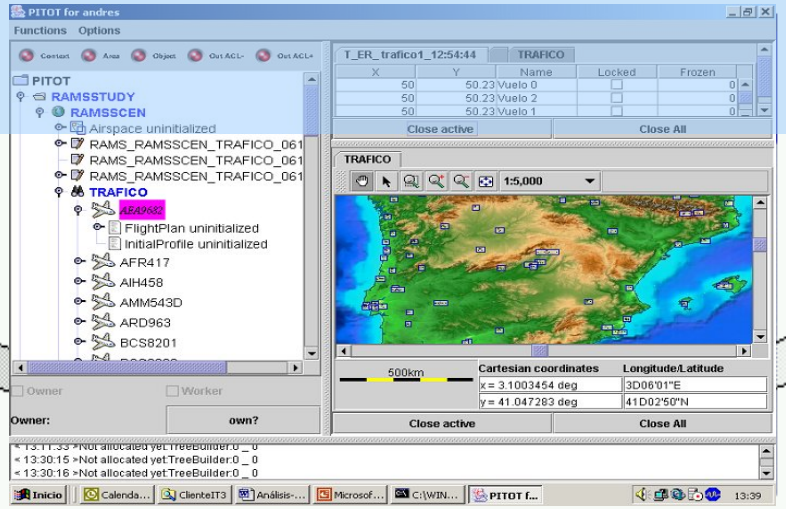
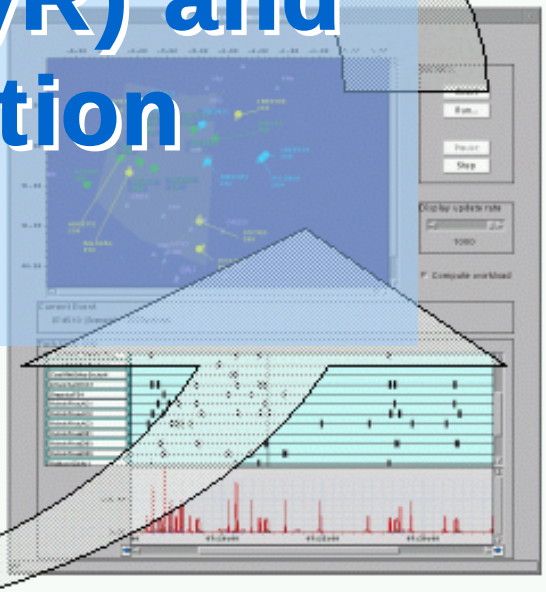
AP9 TIM

Atlantic City, 7th - 8th November 2005

Fut. Concepts (MSP, DyR) and pseudo-TFM simulation







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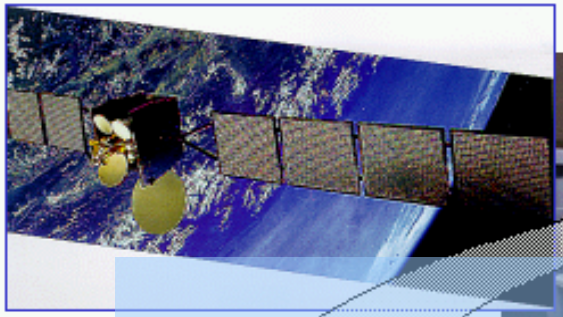
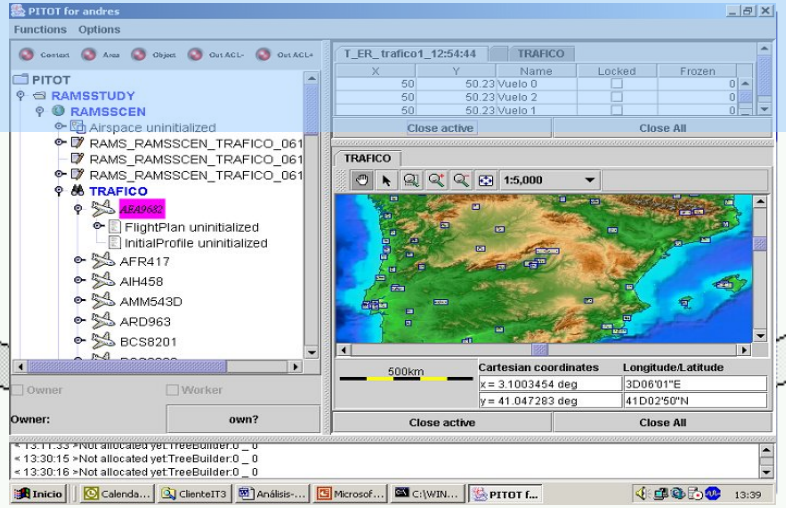
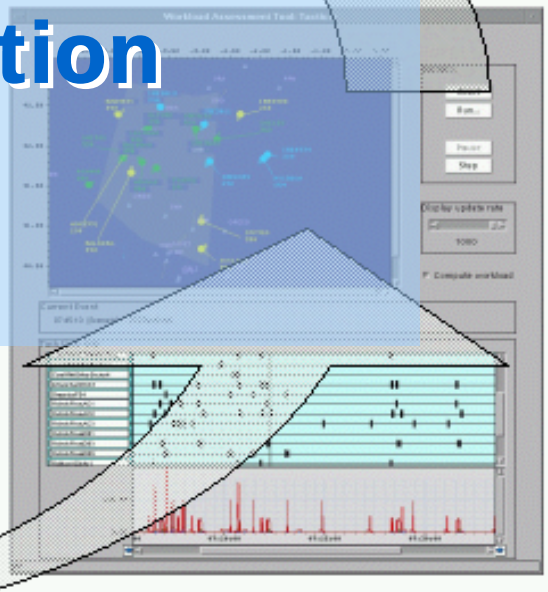
OVERVIEW

- TFM concepts simulation
- Dynamic Re-Sectorization – DyR:
  - DyR: The Concept
  - DyR: The RAMSPlus implementation
  - DyR: Benefits and Conclusions
- Multisector Planner – MSP:
  - MSP: The Concept
  - DyR: The RAMSPlus implementation
  - DyR: Benefits and Conclusions
- Pseudo-TFM simulation
- TFM and FTS integration

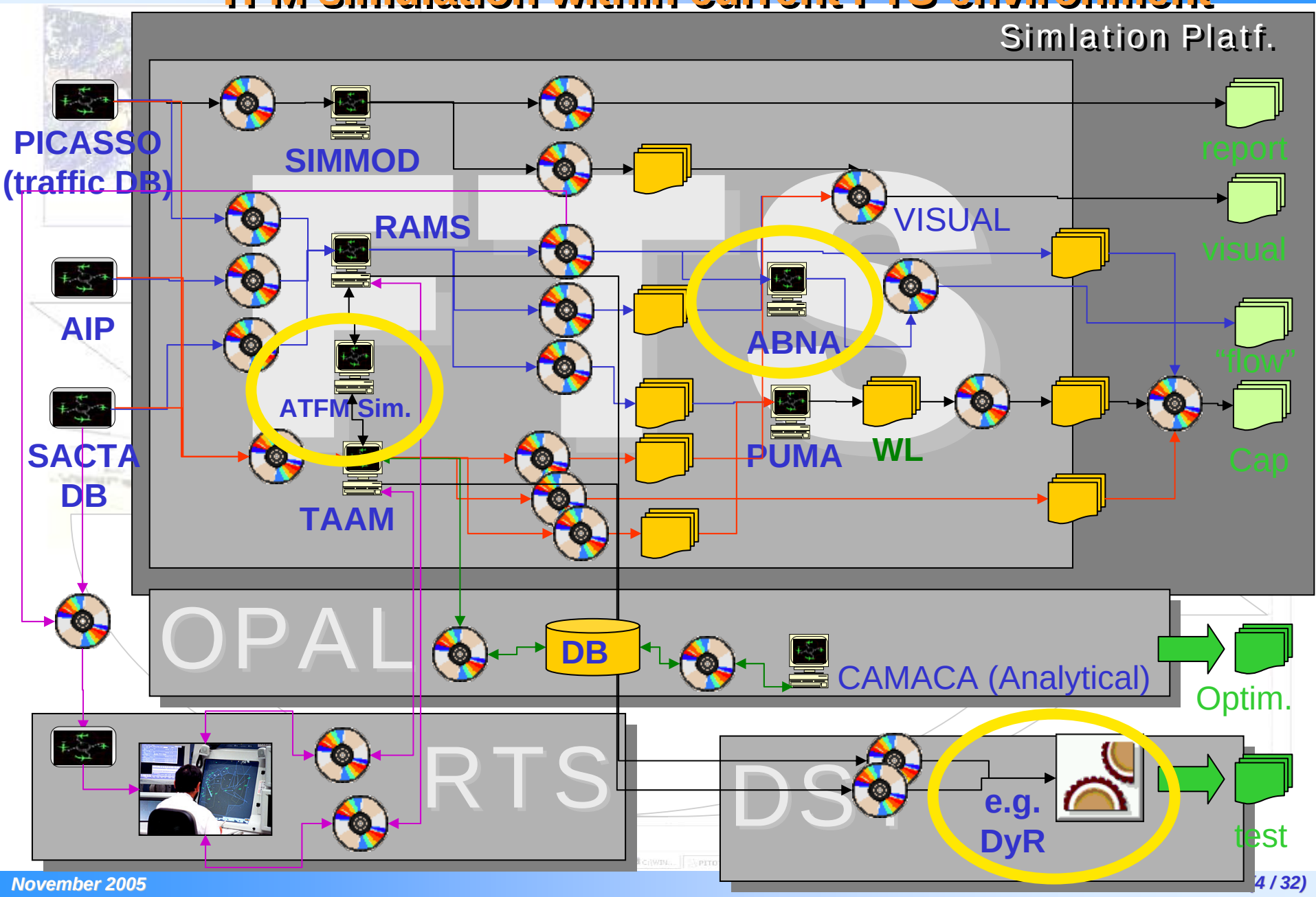
TFM Concepts Simulation





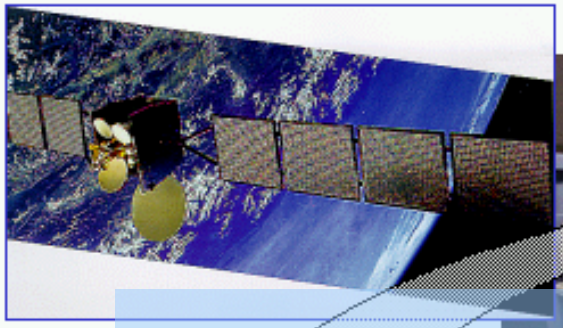


TFM simulation within current FTS environment

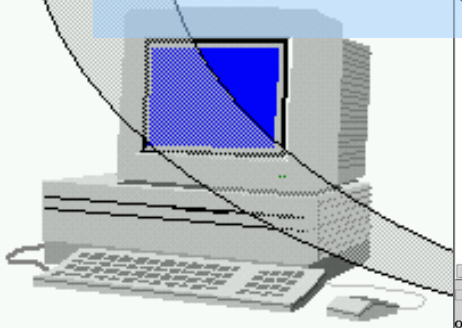


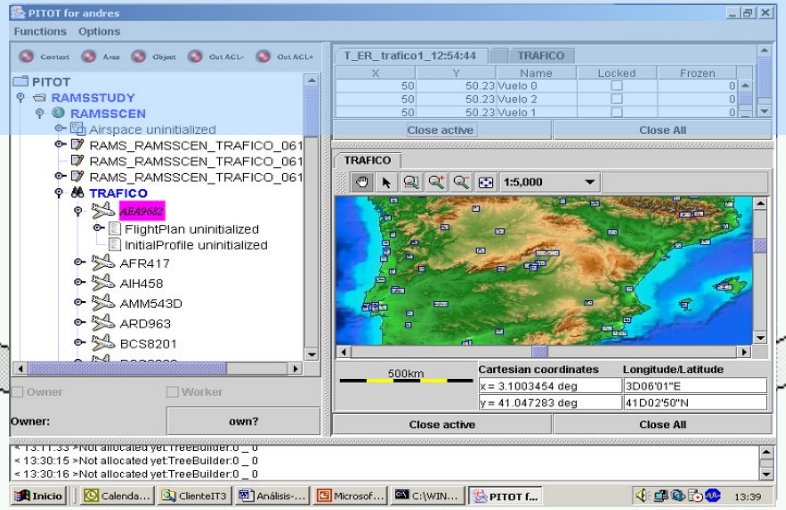
TFM Simulation

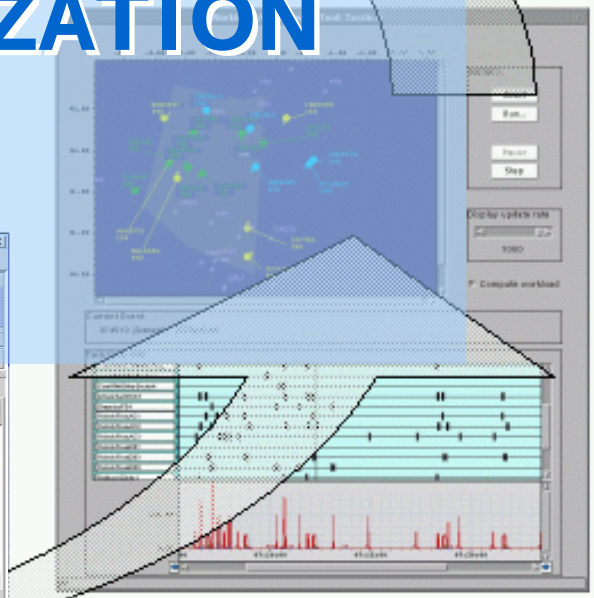
- Future ATM-TFM concepts.
  - E.g. Gate-to-Gate Project: FTS-RTS-FTS
  - Maturity of concepts
  - Critic interrelation with other concepts (TFM)
    - ✓ MSP
    - ✓ DyR
- Pseudo-TFM simulation: E.g.
  - ✓ ABNA
- Integration of TFM components within FTS platform
  - ✓ Platform: PITOT
  - ✓ Components:
    - ATFM components (ATFM sim. E.g. COSAAC, MENTOR…) +
    - ATC simulation components (ATC sim. E.g. RAMS, TAAM…)



DyNAMIC RE-SECTORIZATION (DyR – eTLM)



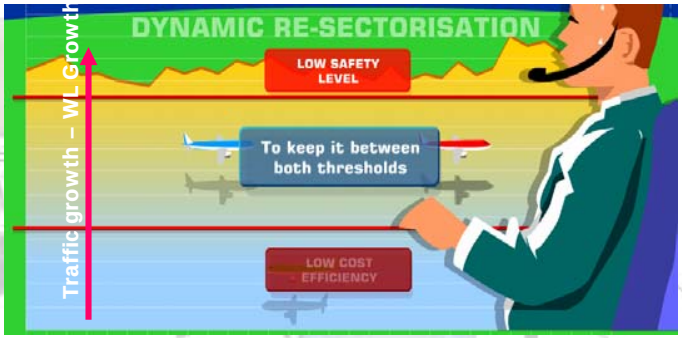




DyR: "The Concept"

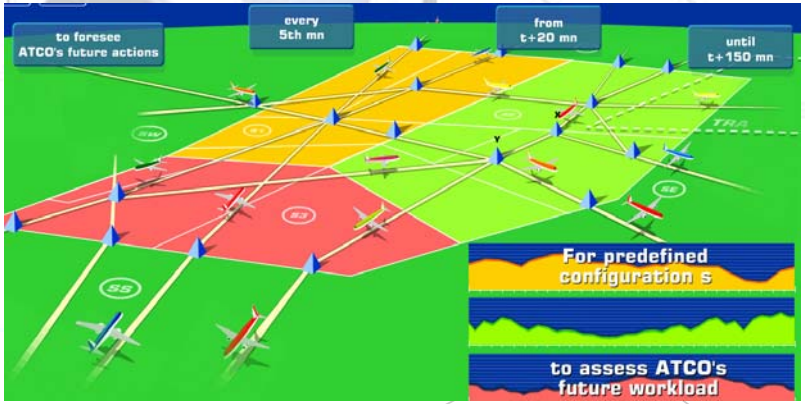
✈ Traffic Complexity Varies along time… So does Controller's Workload!!

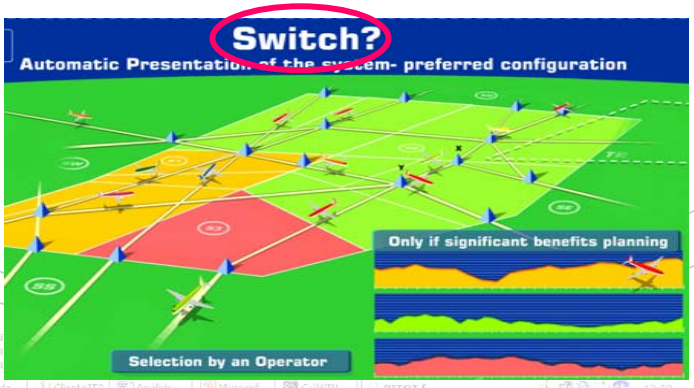
Nowadays, changes of configurations are made depending on fixed capacity, forecasted demand and nature of operations, and supported by ATCOs experience.



✈ In the future, DyR is supposed to switch configuration depending on ATCO's WL assessment.

DyR will foresee ATC future actions every 5', in periods of 20', till 2½ h for predefined configurations ➔ Future WL Assessment



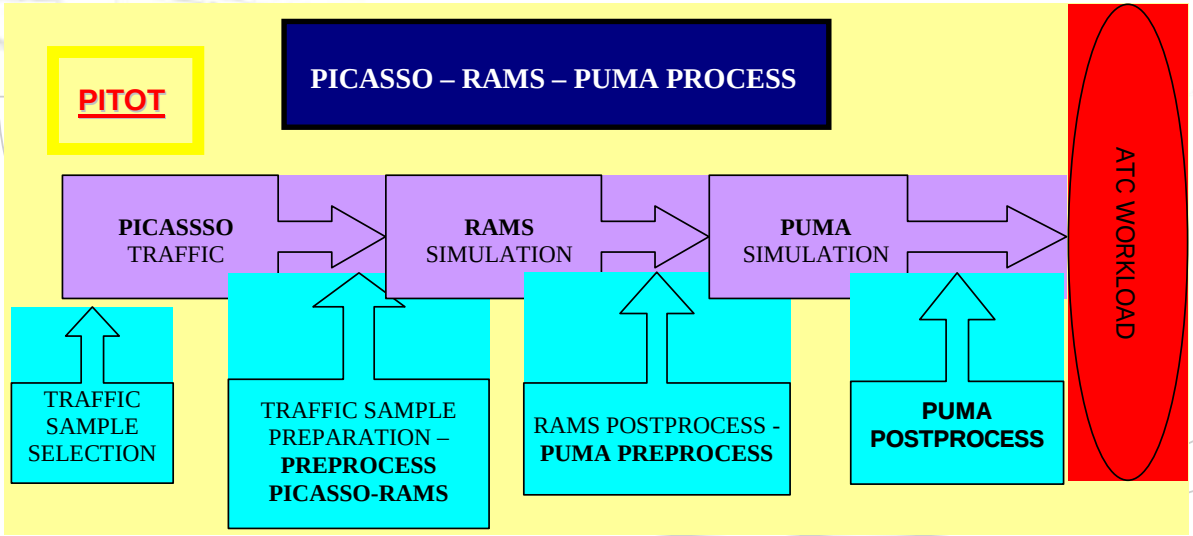


DyR: "The RAMSPlus Implementation"

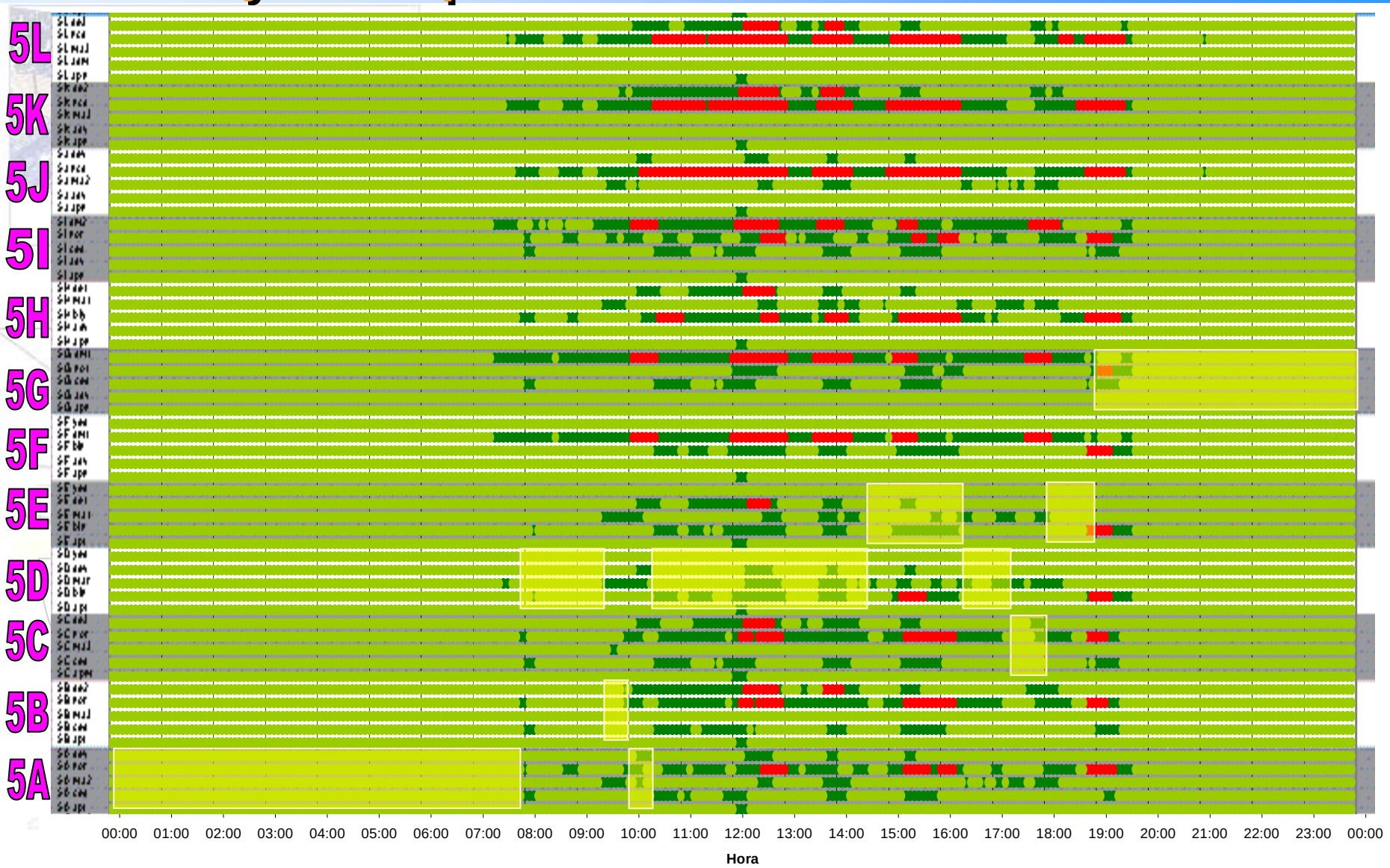
- DyR FTS experiments have been tested on Sevilla ACC Environment.
- Sevilla ACC: elementary volumes ➔ 39 possible predefined configurations (up to six opened sectors configuration)
- Five traffic samples. January to May of 2004 ➔ (39scenarios) x (5timetables) =

  195 (RAMSPlus / PUMA) Simulations

- ANSDD – Aena FTS Platform:

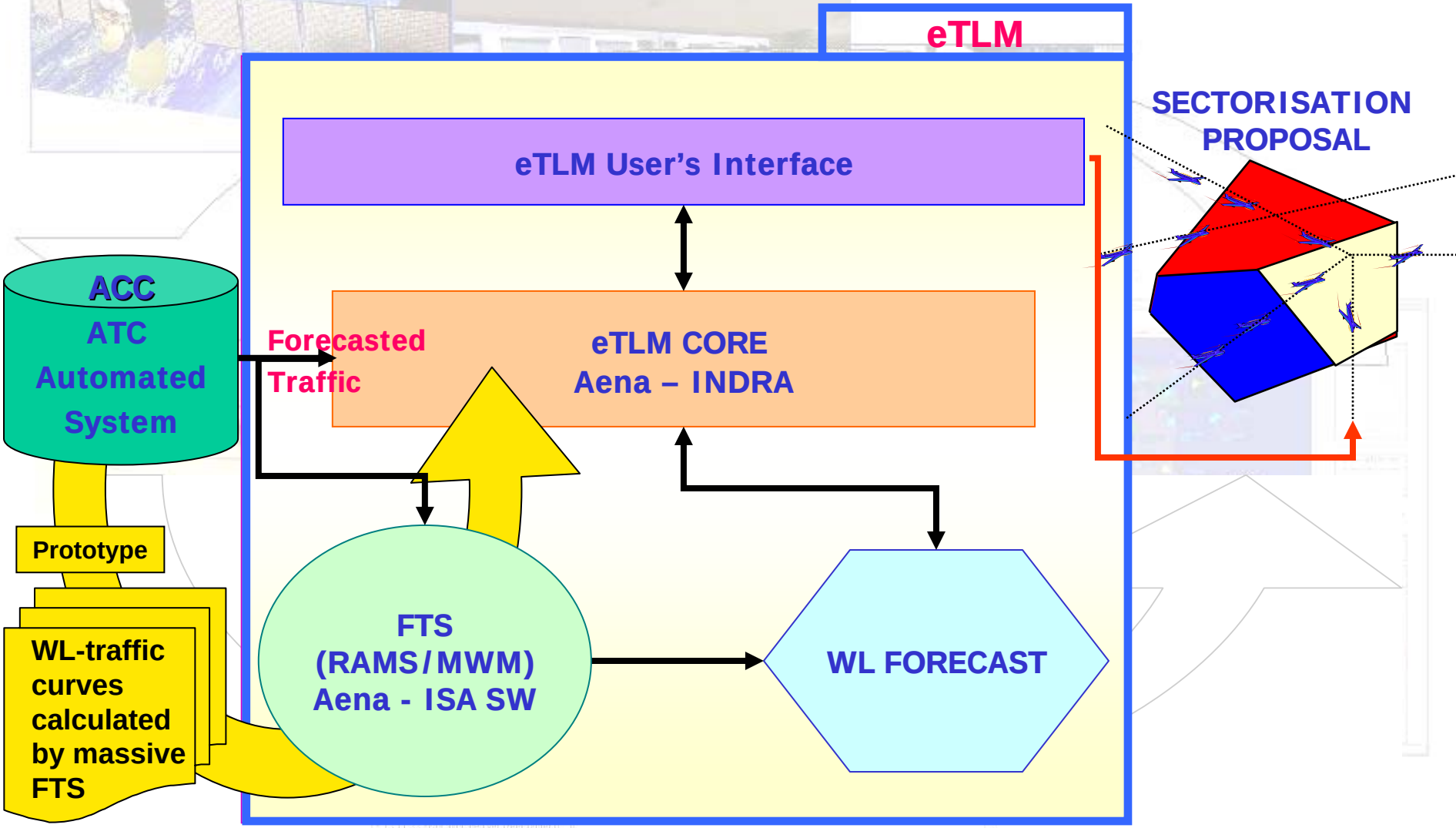


DyR example: 5 SECTORS CONFIGURATIONS



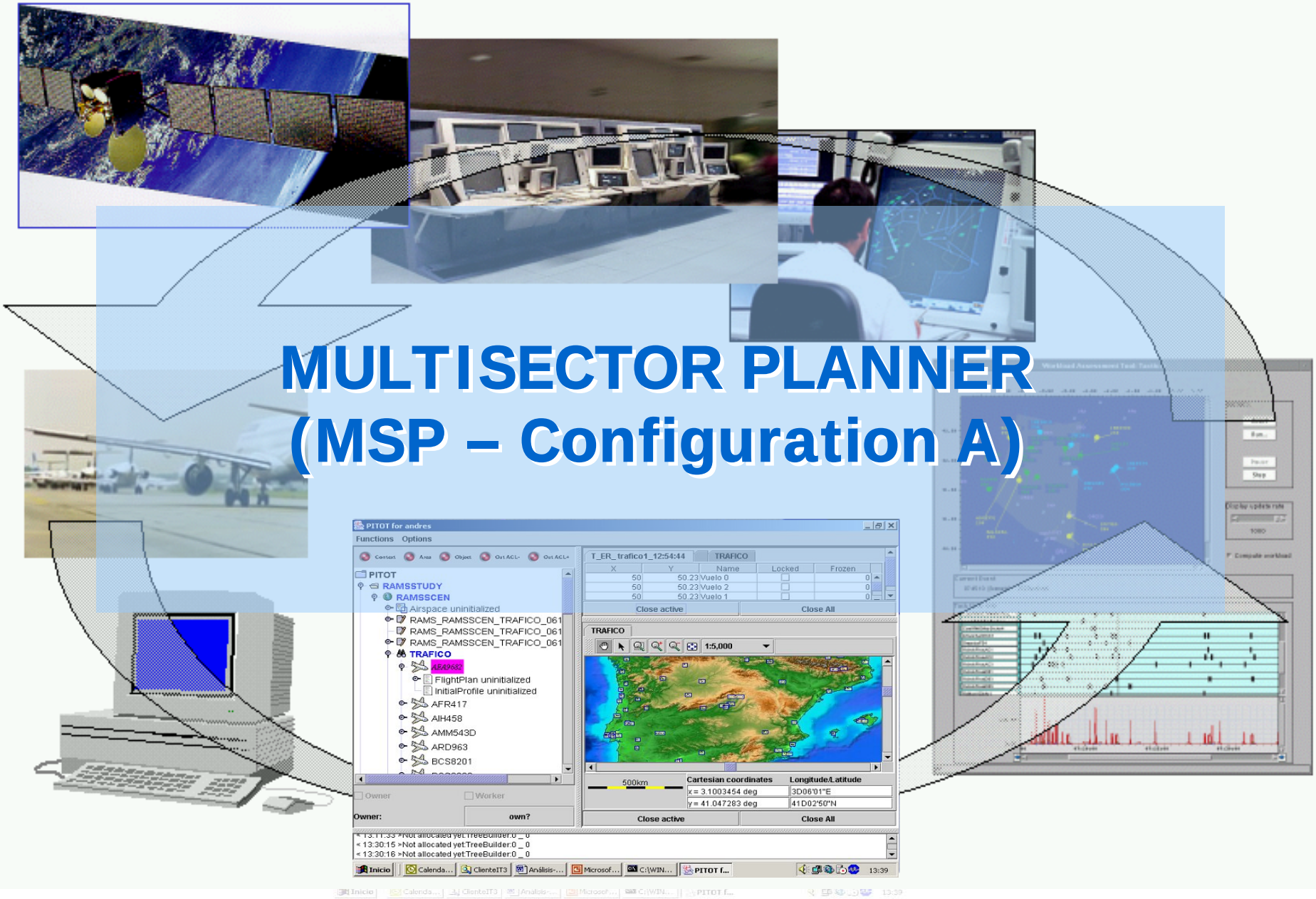
No Saturation Saturation ATC Occupation Time below 40%

eTLM (Enhanced Traffic Load Monitoring) for RTS



DyR – eTLM: BENEFITS AND CONCLUSIONS

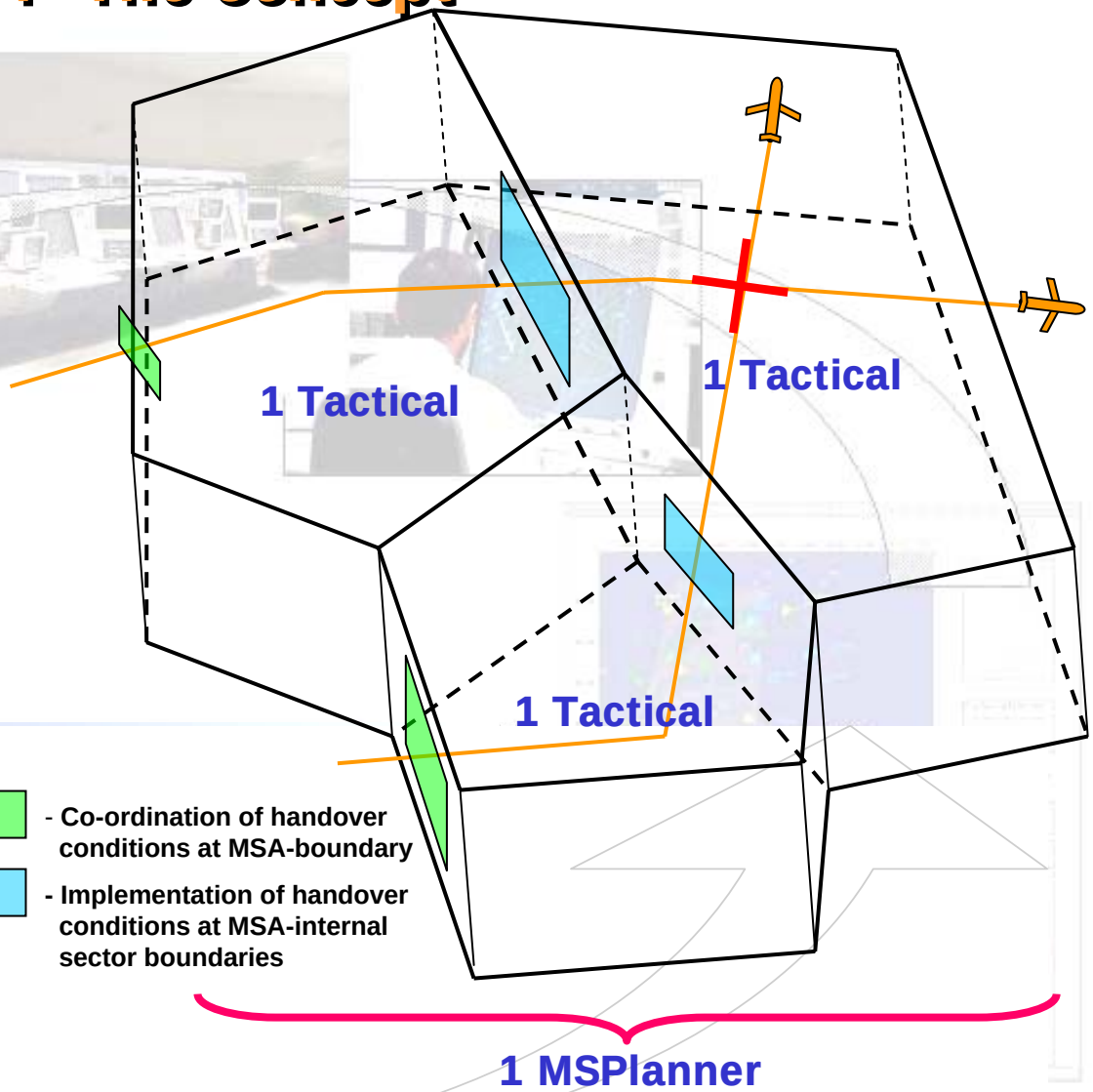
- The main expected benefit of DyR operational concept are:
  - More efficient use of human resources - better balance between traffic and controller workload.
  - Increasing flexibility ➔ reducing controller workload due to a decrease in the traffic complexity.
  - decrease in regulations (better traffic flow management) ➔ better capacity management
- The future TFM implications of DyR concept are:
  - Different process when defining capacity environment: new dynamic capcity realted to dynamic sectors, dynamic demand allotacion, new set of DyR sectors within an area...
- Regarding FTS of DyR:
  - The dynamic way of working with RAMSPlus provided the way for the validation of this new Operational Concept,
  - Provided a massive simulation to build workload-traffic curves for the eTLM prototype, and
  - Enables the FTS engine for the eTLM dynamic presimulation module.



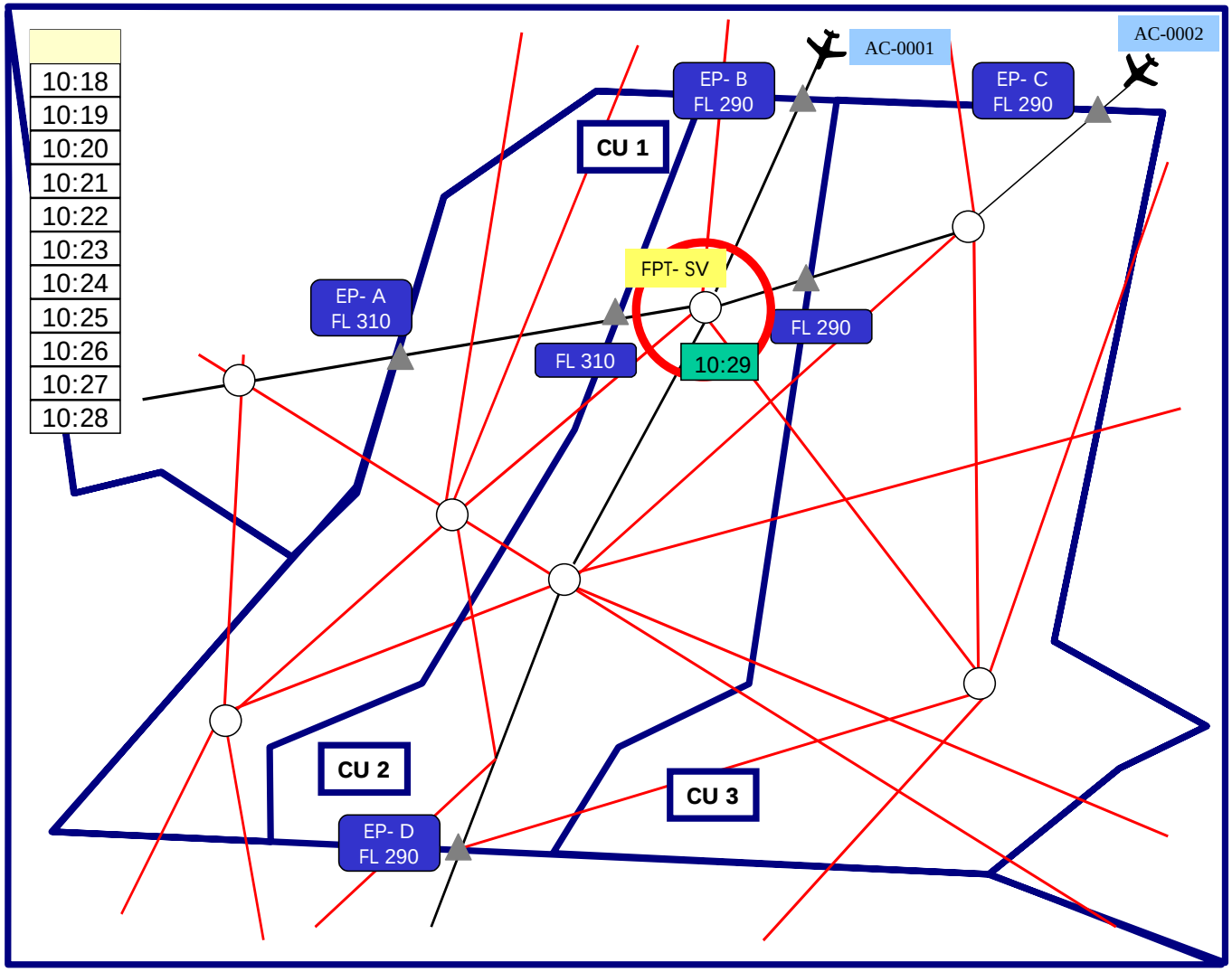
MULTISECTOR PLANNER (MSP – Configuration A)

MSP: "The Concept"

- Target: Reduction of Planner Controller Workload through automation, enabling Planner to handle more than one sector.
- Tasks of MSP: Planning of solutions through sector entry/exit conditions for a sector association instead of a single sector.
- Tasks of Tactical Controller (nearly as today):
  - Deviation of flight track
  - Search for potential conflicts (e.g. < 5min)
  - Planning of solutions within his sector.



MSP – A : Planning Solutions through Entry/Exit Conds.



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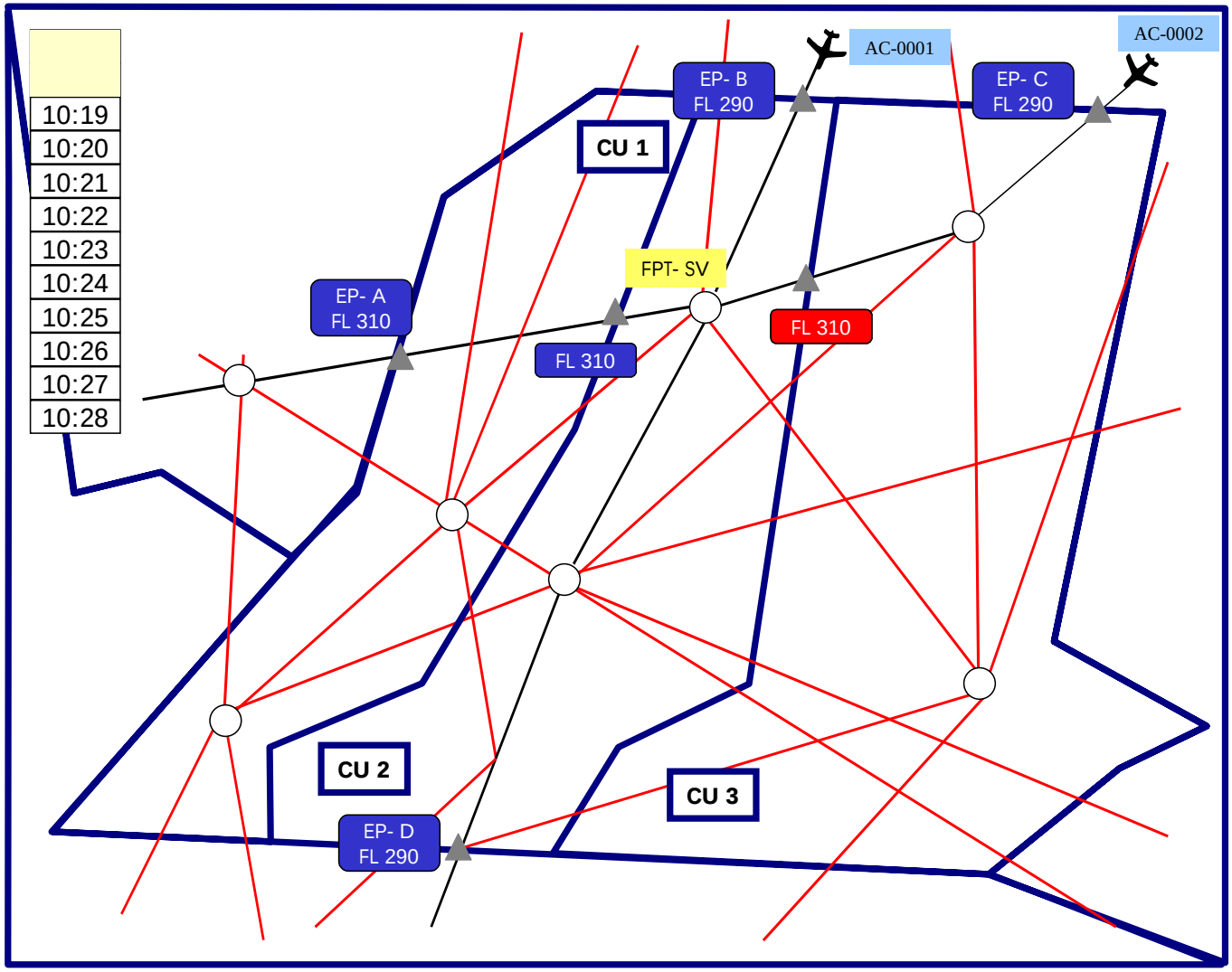

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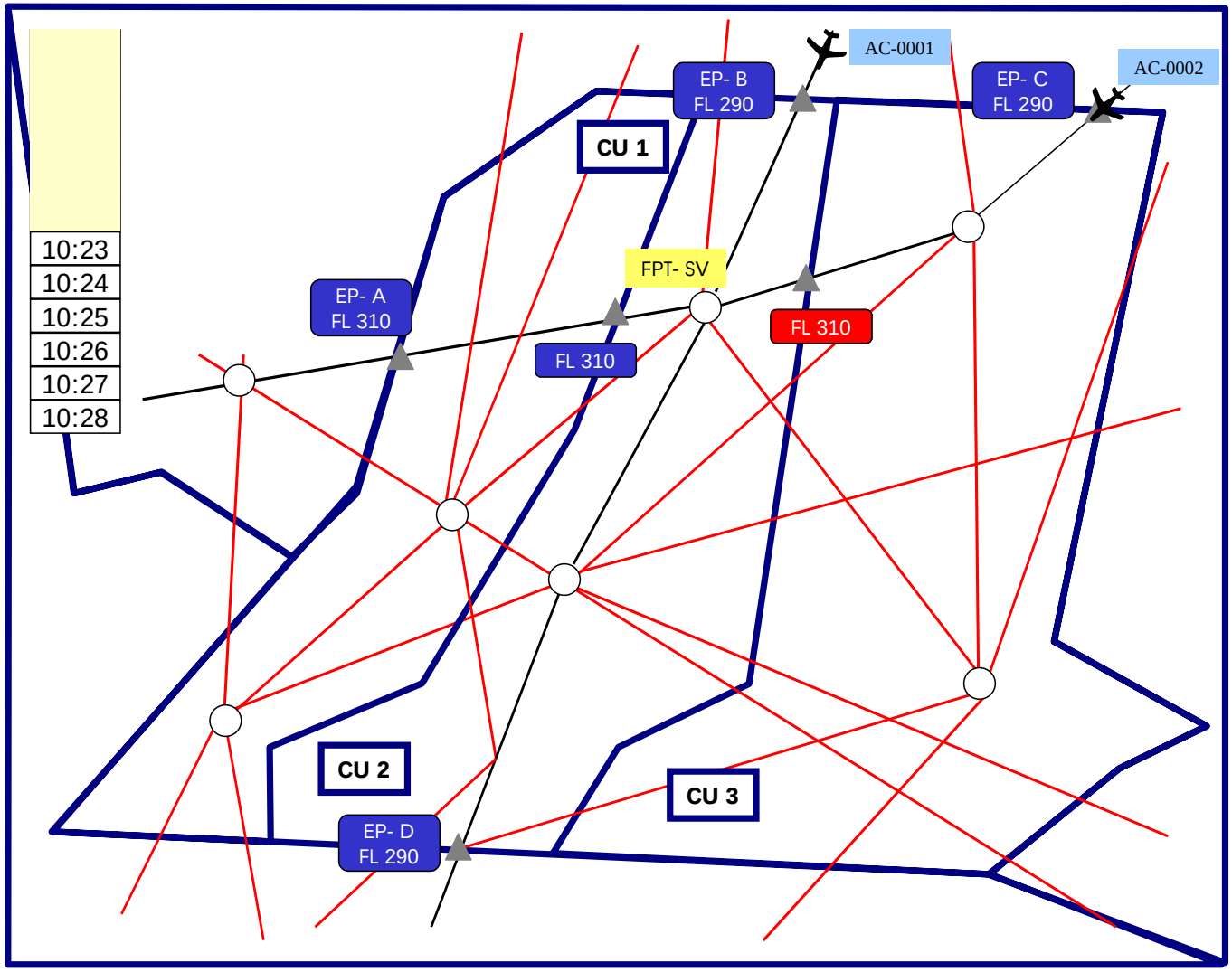

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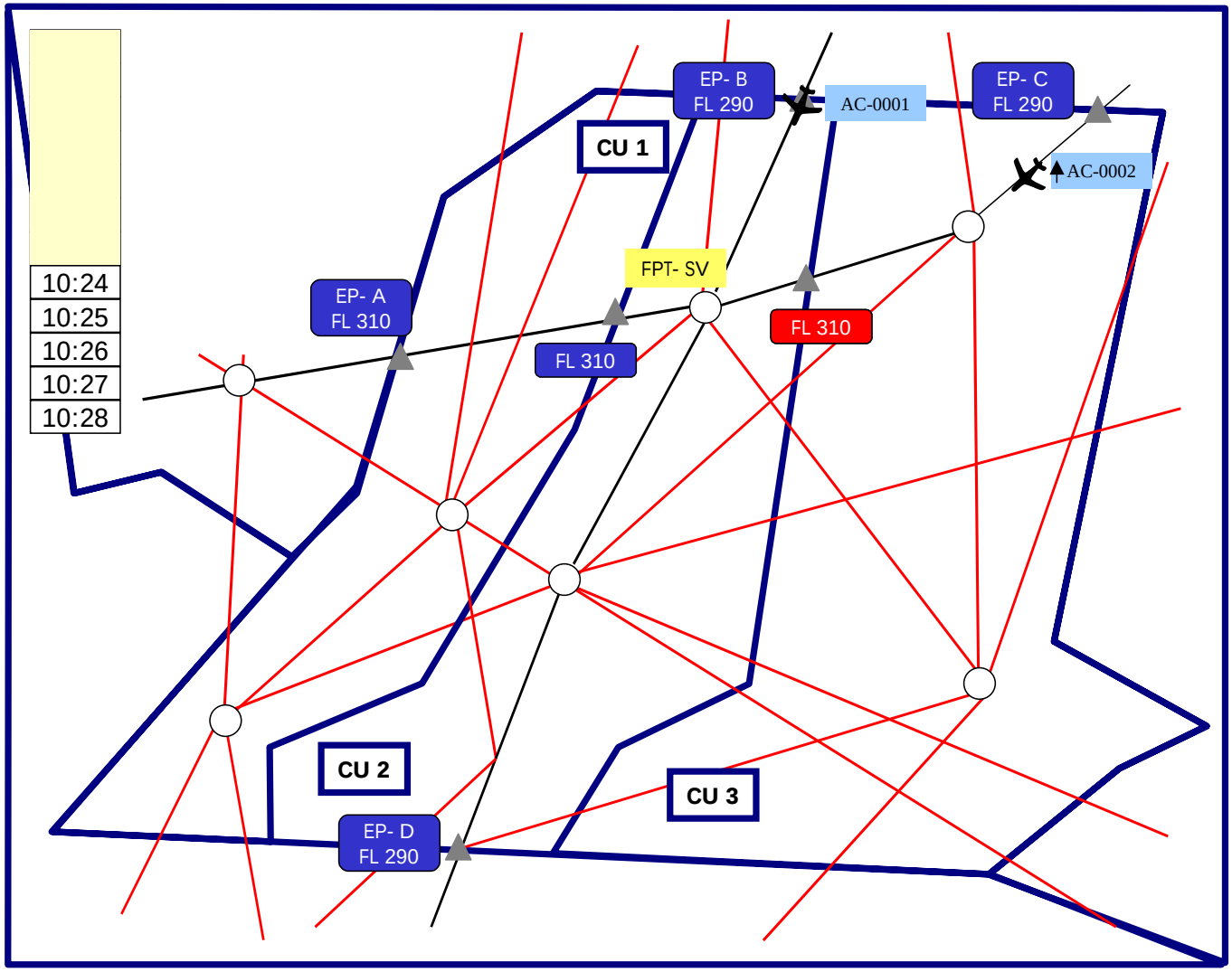

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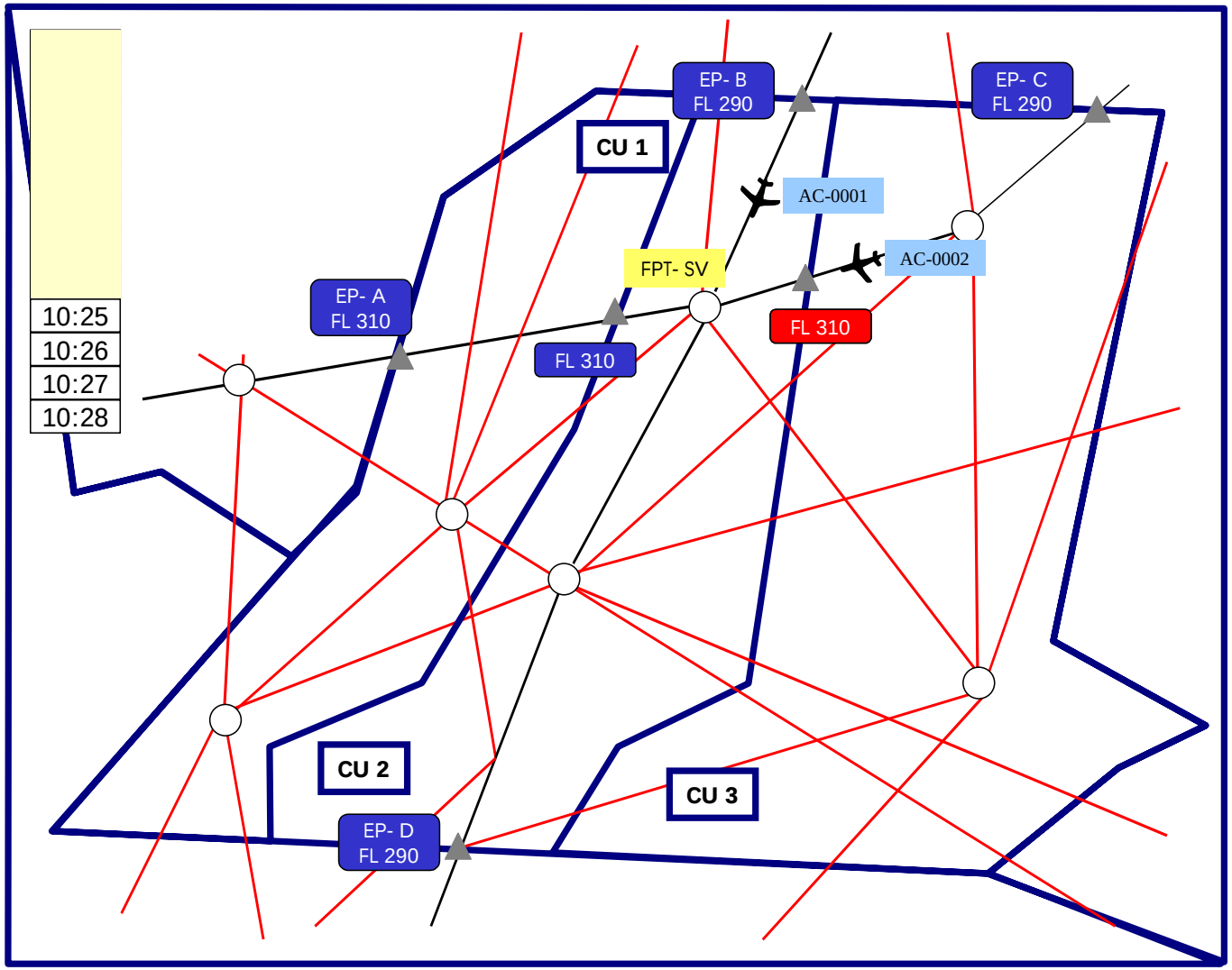

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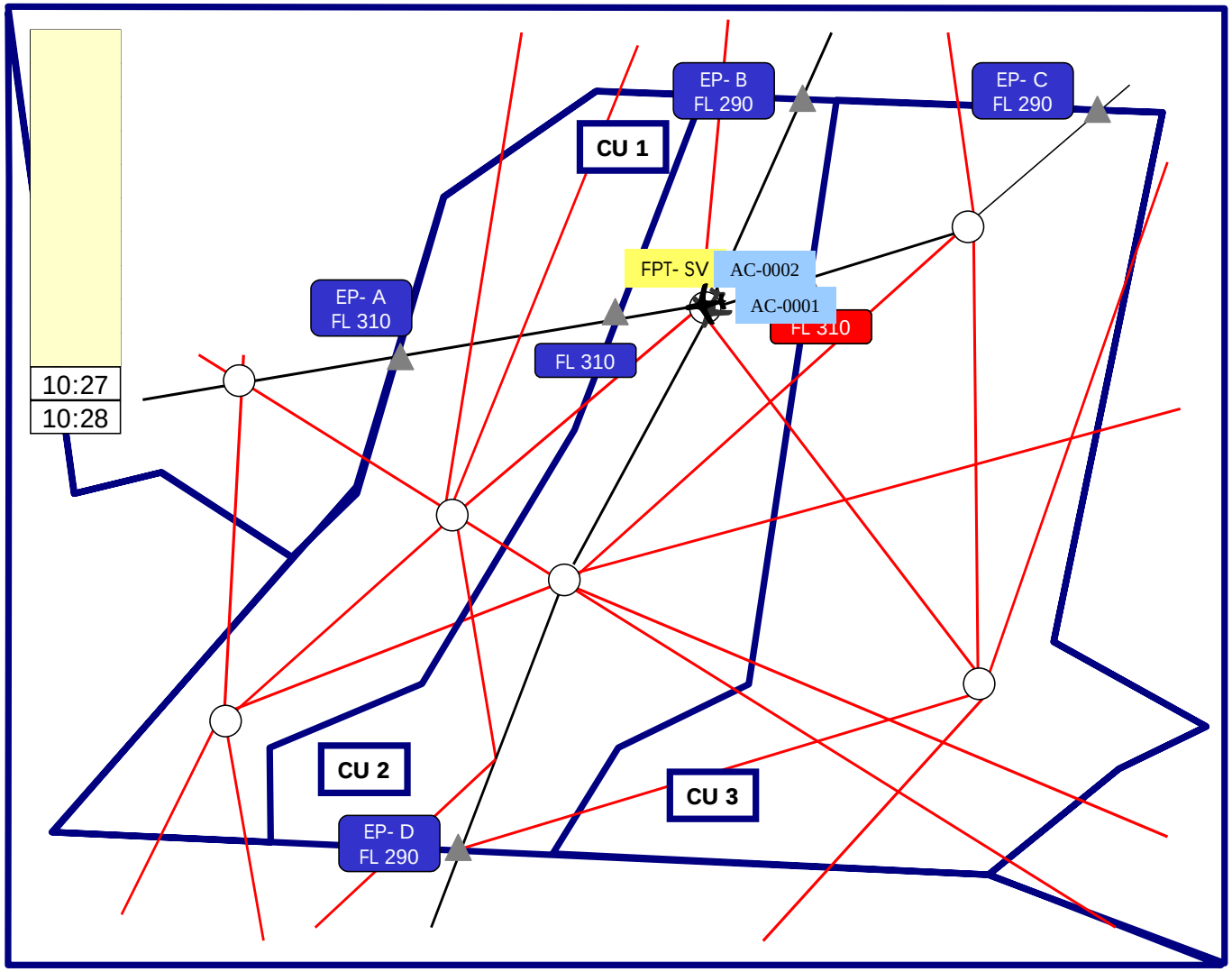

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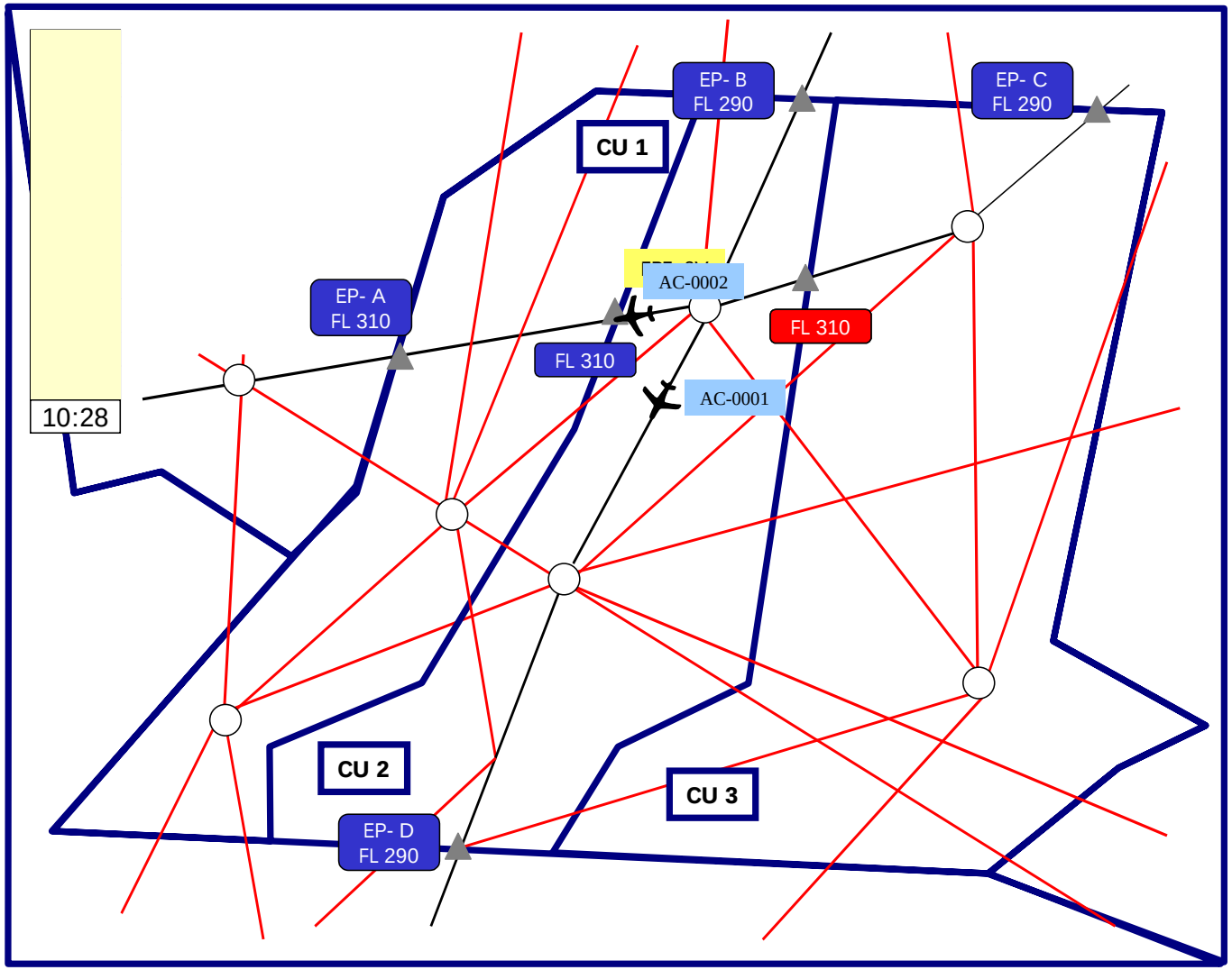
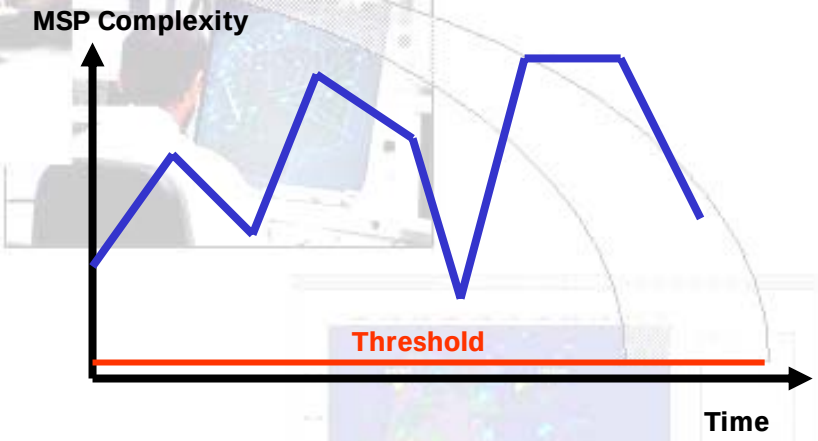


MSP: The RAMSPlus Implementation

- DyR FTS experiments have been tested on Sevilla ACC, with FTS RAMS-PUMA cycle
- How to implement the MSP – MSA specifications in RAMSPlus?



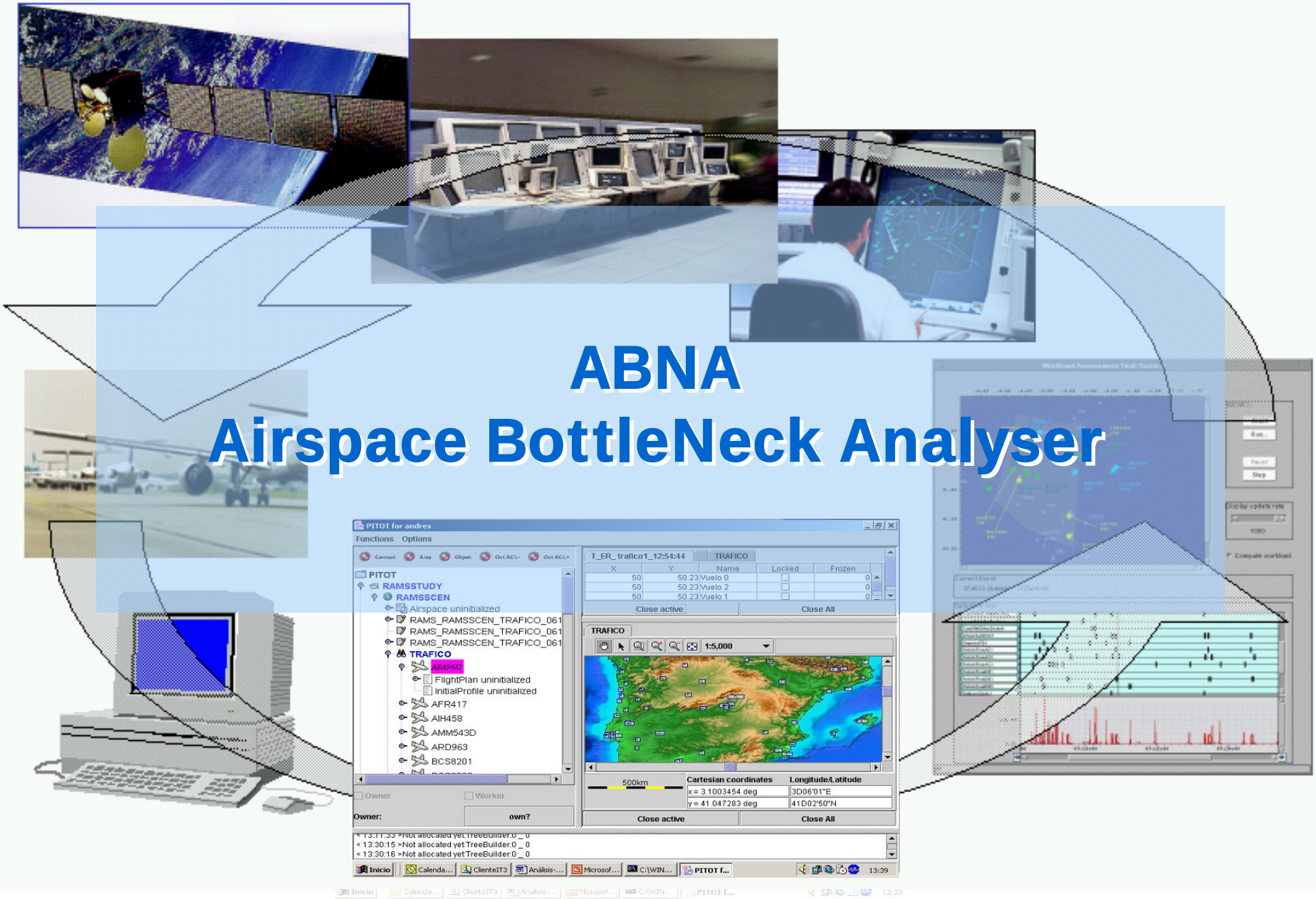
- MSP **Settings**:
  - LookAheadTime: 300”
  - MinExcessDuration: 1.0”
  - Threshold: 0.001
- MSPlanner Rulebase: (**MSPRules**)
  - Conflict **Resolution Facts**:
    - MSP intervention restrictions.
    - VTP (Variable Time Parameter)
    - Candidate Choice
    - TupleSet Rules: Manouvers had to be applied before crossing boundaries.

MSP – A: BENEFITS AND CONCLUSIONS

- The **benefits** of MSP concept are:
  - **Capacity** gain through enhancing sector workload distribution between MSP and tactical controllers. E.g.: **conflicts strategically avoided.**
  - **Efficiency**: new Air Traffic Control layer in European ATM system ➔ execution actions beforehand ➔ **delays, regulations,.. strategically avoided.**
  - **Safety:** MSP operational concept is completely respectful with the required levels of safety of the expected application timeframe.

- The **future TFM implications** of MSP concept are:
  - Different roles when defining capacity environment: MSA combined Capacity, new tactical capcity, dynamic demand allotacion by MSP, dynamic capacity, MSP role at CDM for "delay-travel time" saving

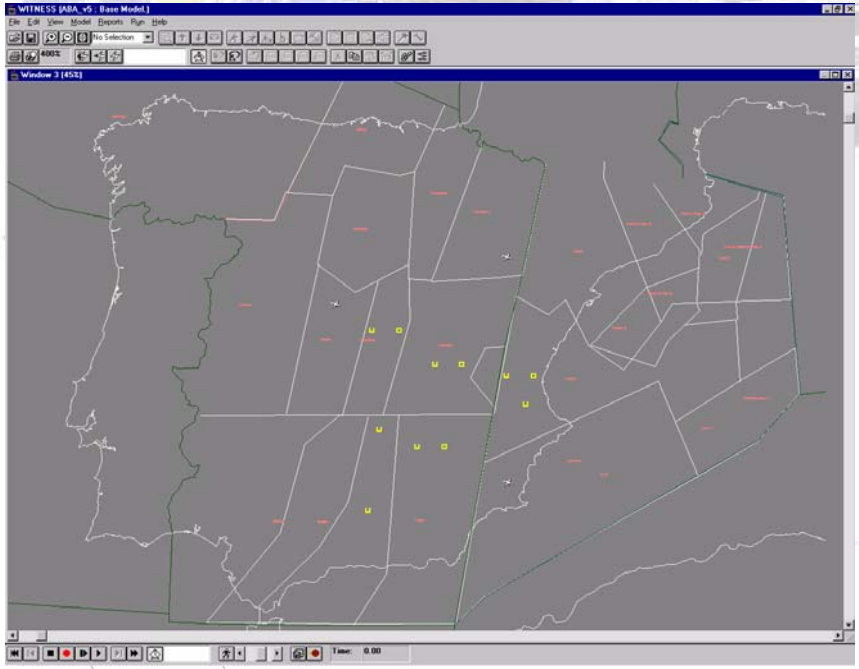
- Regarding **FTS**:
  - RAMS Plus implements MSPlanner role (with customized solutions and patches made available for the MSP simulations)



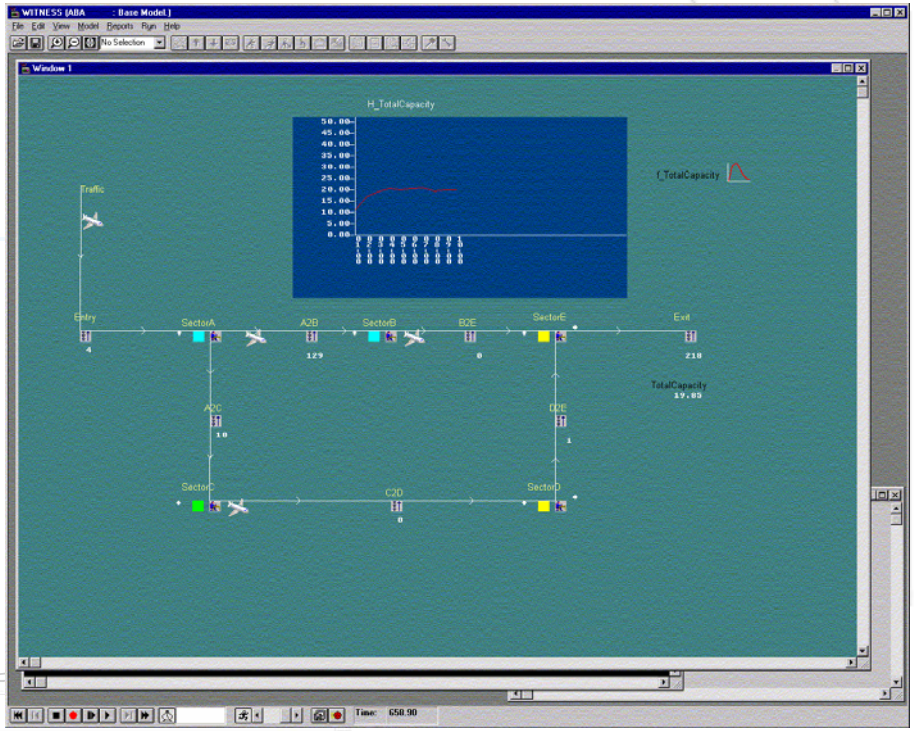
ABNA
Airspace BottleNeck Analyser

ABNA

- Simulation Tool developed by AENA for analysing "gate-to-gate" Networks (Airports+Airspace).



- It enables the analysis of large systems: ACC's, FIR/UIR's, National Airspace, ECAC-wide, ...
- It complements fast-time simulation techniques: RAMS, PUMA, TAAM ...



- Integrated analysis modules:
  - Analyser/optimiser of saturation of sector-airport networks (bottlenecks).
  - Analyser/optimiser of overall system capacity.

ABNA logics

Scope

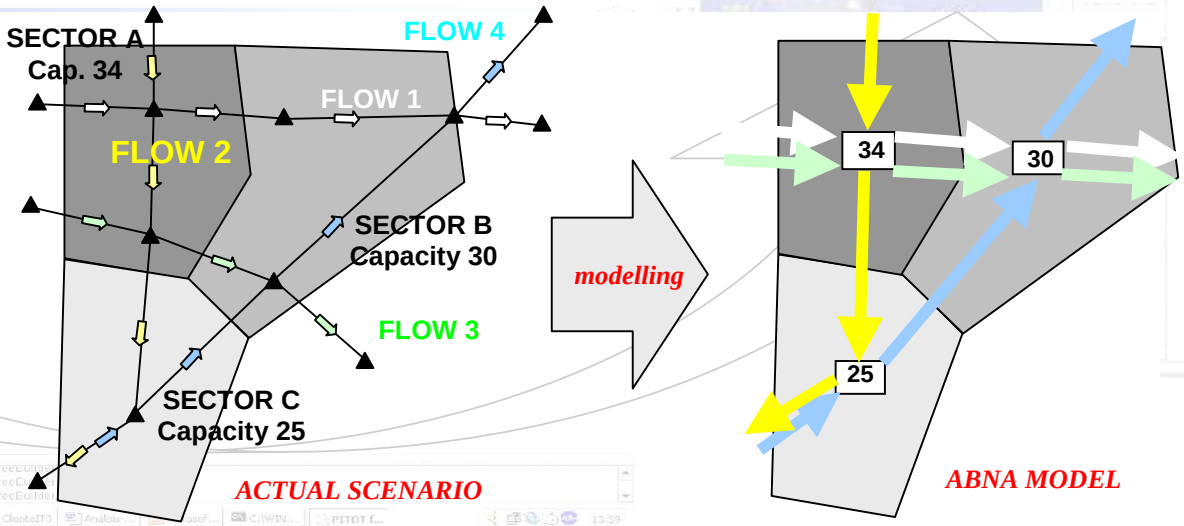
- Complementary technique to FTS: ABNA enables overall system analysis, showing the global impact of local changes (new sectors, new routes, new declared capacities, etc.)
- System optimisation based on its agregated parameters

Basic concepts

- Each sector or airport is modelled as a capacity element (flights per hour). Capacity figures can be obtained from declared capacity or from FTS (RAMS, TAAM, SIMMOD,...).
- Traffic flows take into account:
  - Flown sector sequence.
  - Average time to cross a sector using a given route.
  - Traffic can be based on average flows, actual flight-plans or generation/cloning facilities (e.g. from RAMS).
- Dynamic simulation: simulation evolves with time in a queue-process model.

Results

- Dynamic analysis of bottlenecks: sector-based and hourly rate distribution due to "pseudo-delays" and "pseudo-regulations"
- Overall system Capacity: total flights per hour throughput.



ABNA Evolution

ABNA Prototype (2001)

Technology: WITNESS queue general purpose model

Algorithm:

- ✈ FIFO queue
- ✈ Flights realocation (regulation) with constant delay at injection
- ✈ Respect nodes (sectors) capactities

- Slow
- Unrealistic delay/regulation estimations
- Stable overall capacity estimation

ABNA Intermediate (2003)

Technology: JAVA

Algorithm:

- ✈ Entry time optimisation
- ✈ Flights realocation (regulation) with optimum delay at injection
- ✈ Respect nodes (sectors) capactities

- Quick
- More realistic delay/regulation estimations
- Unstable overall capacity estimation

ABNA PITOT (2005)

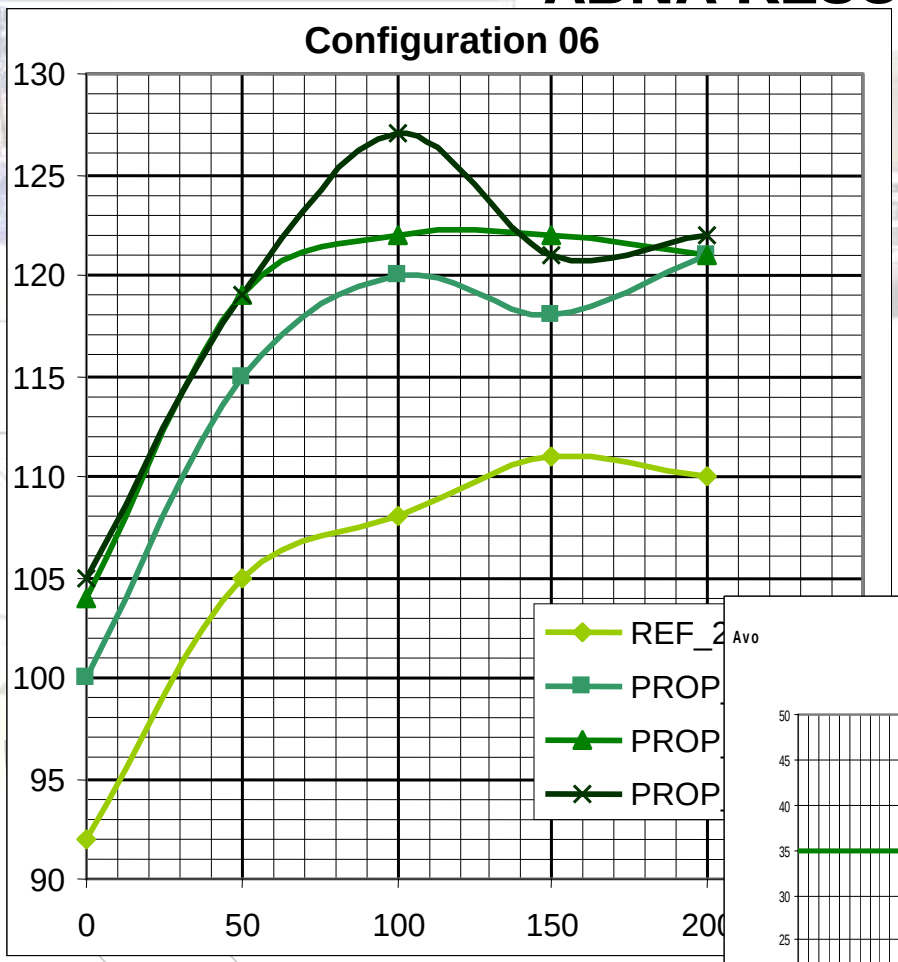
Technology: JAVA

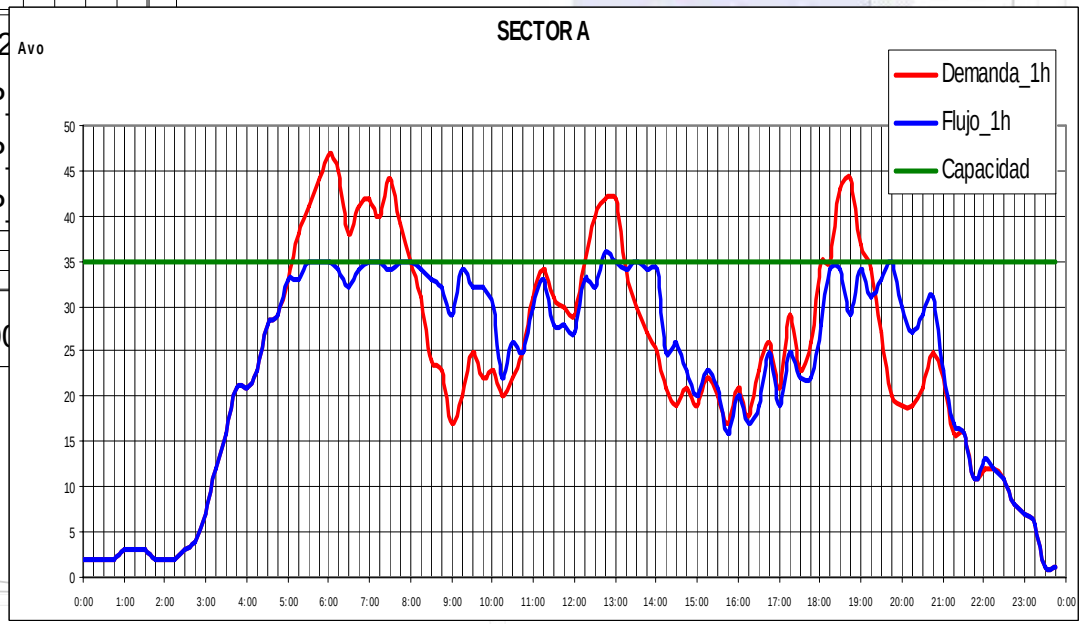
Algorithm:

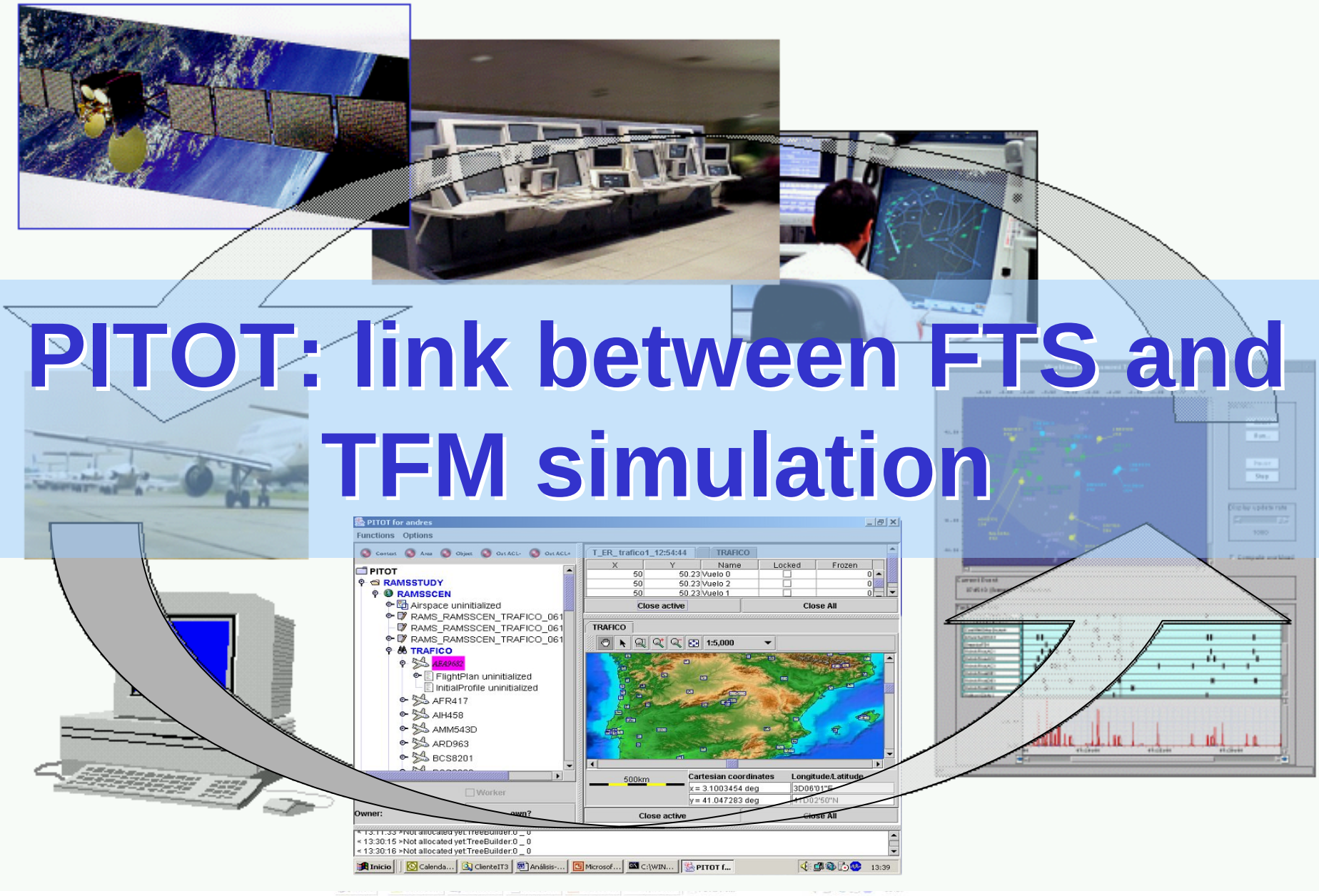
- ✈ Flexible regulation model:
  - ✈ FIFO queue
  - ✈ Entry time optimisation
  - ✈ Even ATFM allocation
- ✈ Flights realocation (regulation) with parametric delay at injection
- ✈ Respect nodes (sectors) capactities

- Quick & flexible
- Realistic delay/regulation estimations
- Stable overall capacity estimation

ABNA RESULTS, e.g.:

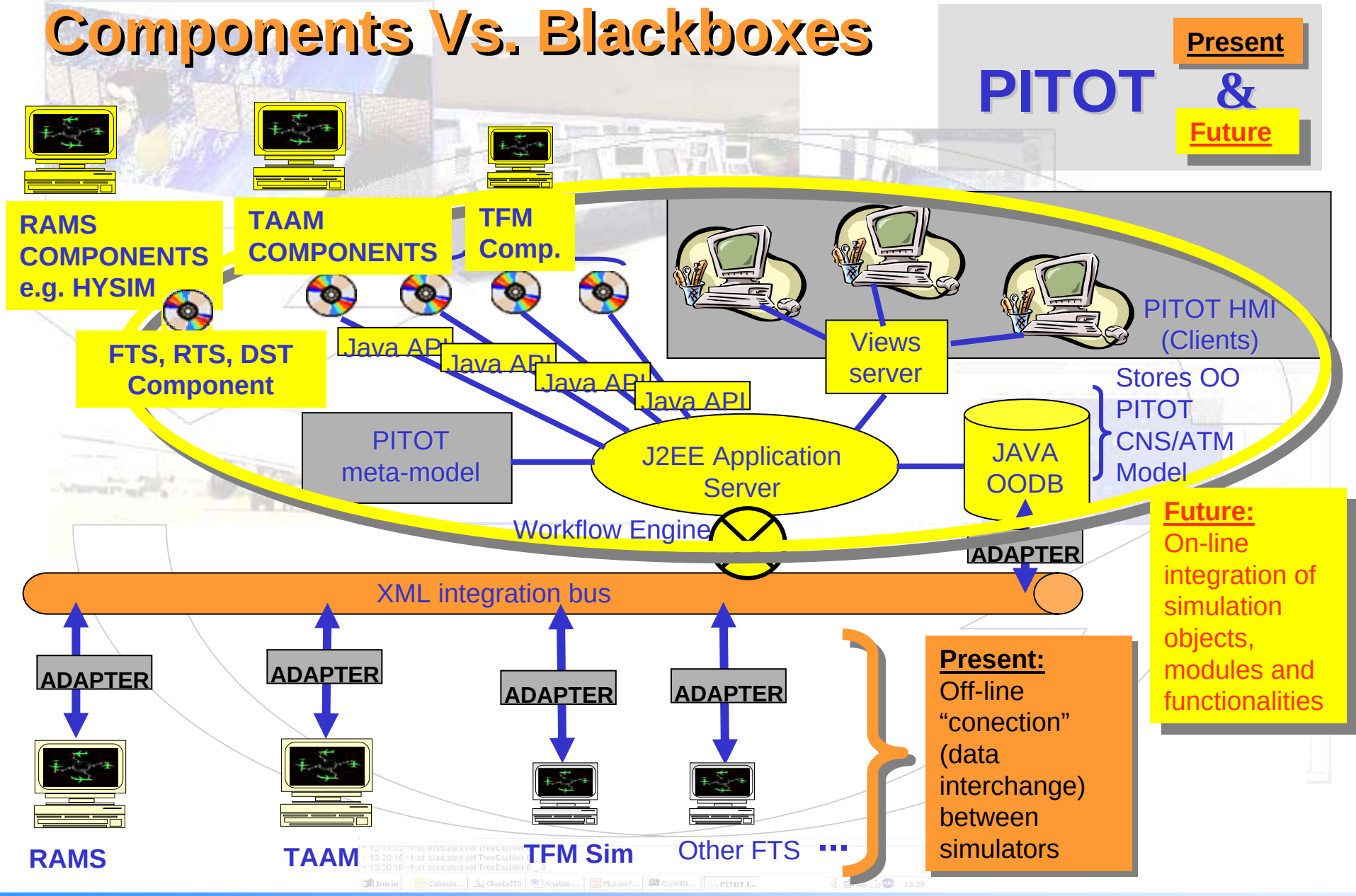


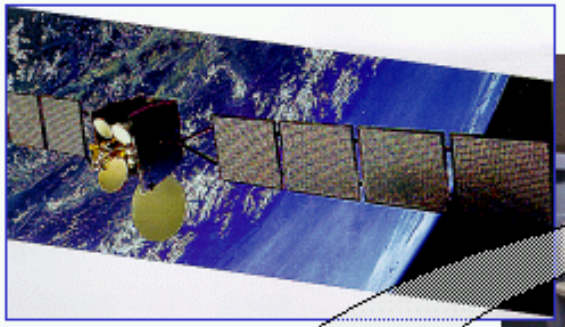


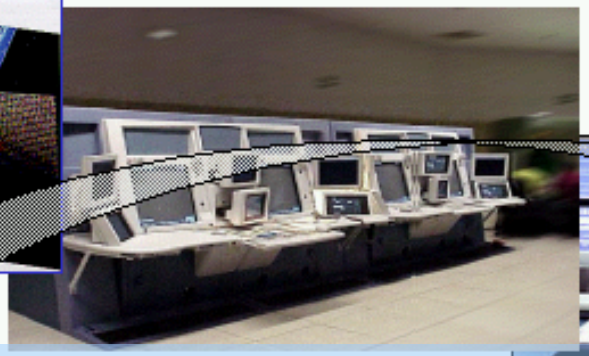


PITOT: link between FTS and TFM simulation

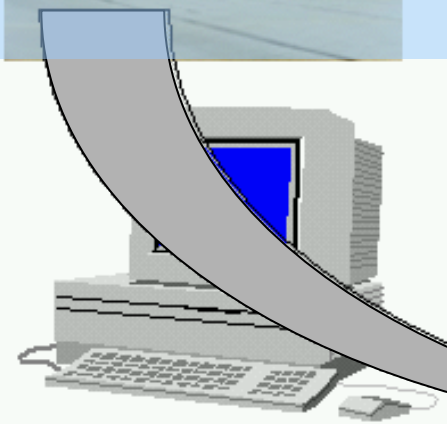
Components Vs. Blackboxes

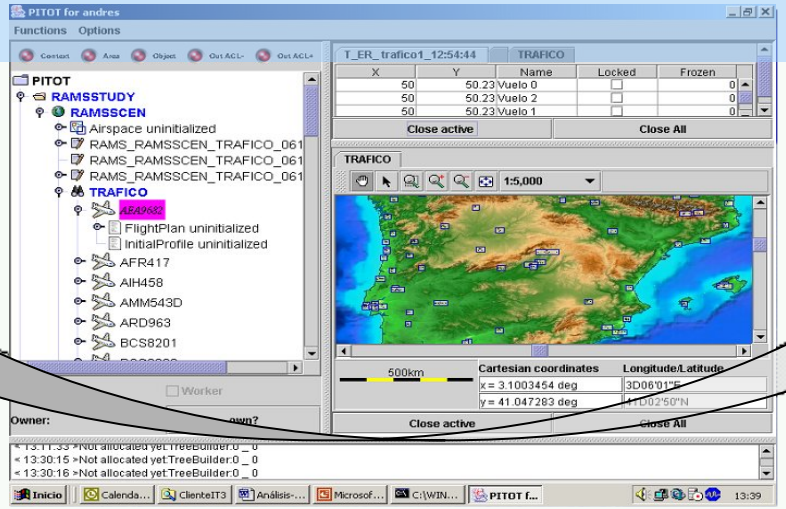


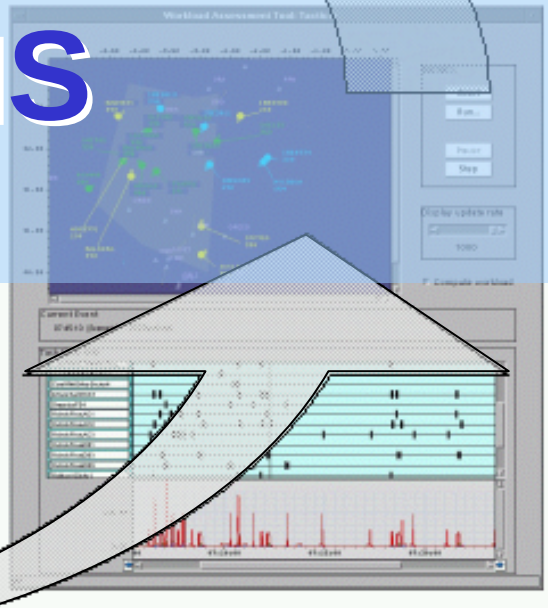




CONCLUSIONS







Conclusions

- Some future ATM-TFM concepts can be simulated, to some extent, by current FTS tools
  - ✓ MSP
  - ✓ DyR
- Pseudo-TFM simulation provides means for analysis of delay-saving and overall capacity of wide airspaces.
  - ✓ ABNA
- Integration of TFM components with FTS could provide a more realistic simulation environment
  - ✓ PITOT
  - ✓ Using ATC Sim and TFM Sim Components